Reasoning in the classroom

Pinocchio

Support materials for teachers

Year 5

Llywodraeth Cymru
Welsh Government

Year 5 Reasoning in the classroom – Pinocchio

These Year 5 activities are based around the puppet Pinocchio and his ability to grow (and shrink) parts of his body. The first activity was included in the 2015 National Numeracy Tests (Reasoning). This is followed by one further activity.

Activity 1

Pinocchio

Learners use the information provided to work out the number of lies and truths told by Pinocchio over different time periods.

Includes:

- Teachers' script
- PowerPoint presentation
- Pinocchio questions
- Markscheme

Activity 2

Pinocchio's challenge

Learners explore different ways to interpret an instruction to draw their hand when its measurement has doubled, and consider the implications of the lack of clarity in the instruction.

Includes:

- Explain and question – instructions for teachers
- Whiteboard – Pinocchio's challenge
- Whiteboard – Different doubling
- Teachers' sheet – Different doubling: solutions
- Whiteboard – Doubling all over
- Whiteboard – Truly doubled

Reasoning skills required

Identify	Communicate	Review
Learners identify relevant number facts and mental strategies; they select appropriate techniques to use.	They work together to develop their strategy and present their work orally, pictorially and in written form, explaining their responses.	They consider their own choices, and explore the implications of there being alternative approaches to the task.

Procedural skills

- Addition
- Subtraction
- Multiples (3, 5, 15)
- Measuring (cm)
- Doubling
- Area (optional)

Numerical language

- Longer/shorter
- cm
- Length, width
- Double
- Area
- cm^2
- Scale factor (optional)

Activity 1

Pinocchio

Activity 1 – Pinocchio

Outline

This Year 5 activity requires learners to use the information given to work out how many lies and how many truths Pinocchio has told on different days.

You will need

Teachers' script

PowerPoint presentation

Pinocchio questions
Two pages for each learner, can be printed double-sided

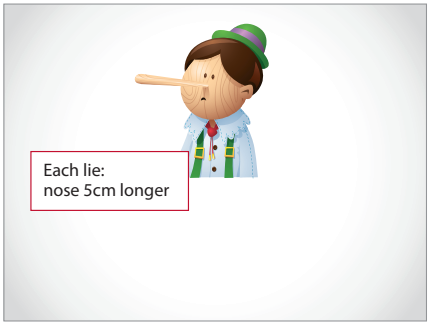
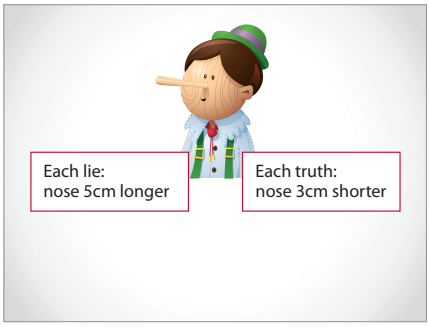
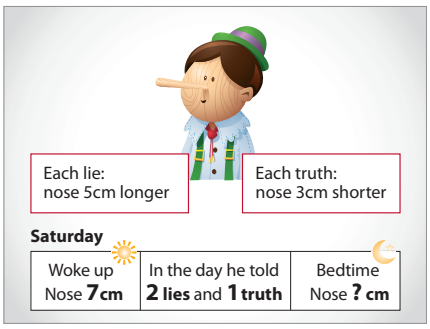
Markscheme

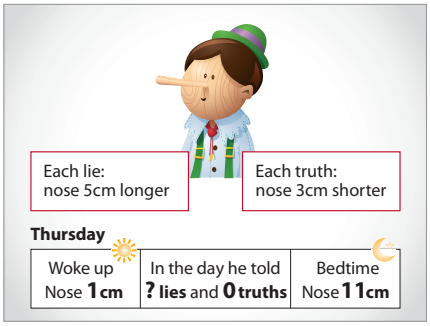
TS

Presentation to be shown to learners before they work on Pinocchio

The text in the right-hand boxes (but not italics) should be read to learners. You can use your own words, or provide additional explanation of contexts, if necessary. However, if you are using this as an assessment item, no help must be given with the numeracy that is to be assessed.

Slide 1		*(Keep this slide on the screen until you are ready to start the presentation.)*
Slide 2		Does anyone know who this might be? It is Pinocchio. He is a wooden puppet who comes from a very famous story and film.
Slide 3		This man *(point)* is Gepetto. He made the wooden puppet but then, by magic, Pinocchio came to life! Gepetto loves Pinocchio like a son. But there is one thing that makes him very sad. Pinocchio tells lies. And every time he tells a lie . . .
Slide 4		. . . his nose grows longer! *(Mimic his nose growing longer.)* He keeps telling lies, and his nose grows longer and longer. I wonder how he can get his nose shorter again?

Slide 5		How do you think his nose might get shorter? That's right, if he tells the truth. Each time Pinocchio tells a lie, his nose grows longer. *(Mimic it growing.)* Each time Pinocchio tells the truth it gets shorter. *(Mimic it shrinking.)* But how much longer and shorter I wonder?
Slide 6		For each lie he tells, his nose gets 5cm longer. How much longer would it be after two lies? That's right, 10cm longer, because it grows 5cm and then another 5cm. *(Do not refer to multiplication.)*
Slide 7		For each truth he tells, his nose gets 3cm shorter. How much shorter would it be after two truths? Yes, 6cm shorter, because it gets 3cm shorter and then another 3cm shorter. *(Do not refer to multiplication.)*
Slide 8		Here is what happened to Pinocchio's nose on Saturday. How long was his nose when he woke up? *(Support reading of the table: his nose was 7cm.)* In the day he tried to be good but what happened? *(Point to the information: he told 2 lies and 1 truth.)* So, how long was Pinocchio's nose at bedtime on Saturday? *(Allow discussion then agree it was 14cm because 7 + 5 = 12, then 12 + 5 = 17, then 17 – 3 = 14. If necessary, show these calculations on a whiteboard, but do not suggest alternative methods.)* Let's look at one more day . . .

Slide 9		What day was it? *(Thursday)* What was the length of Pinocchio's nose when he woke up? *(1cm)* What was the length at bedtime? *(11cm)* He didn't tell any truths on Thursday *(point to 0 truths)*. Talk with the person next to you. How many lies did he tell? *(Allow discussion, then agree that he told 2 lies because his nose grew 10cm and 5 + 5 = 10)* Well done. Now you are going to answer some questions about what happens to Pinocchio's nose on other days. Remember to set out your work clearly so that someone else can understand what you are doing and why. *(If you are using this item for assessment purposes, you may wish to limit the time available, e.g. 10 minutes.)*

Each **lie**: nose **5cm longer**	Each **truth**: nose **3cm shorter**

Tuesday

Woke up Nose **8cm**	In the day he told **1 lie** and **1 truth**	Bedtime Nose **?cm**

How long was his nose at bedtime on Tuesday?

cm

1m

Friday

Woke up Nose **15cm**	In the day he told **1 lie** and **? truths**	Bedtime Nose **8cm**

Work out how many **truths** he told on Friday.

truths

2m

Each **lie**:
nose **5cm longer**

Each **truth**:
nose **3cm shorter**

On Sunday, he told **3 lies** and **5 truths**.

Was his nose the **same length** at bedtime as when he woke up?

Show how you know.

1m

On Monday, he told **more than 3 lies**.

His nose was the **same length** at bedtime as when he woke up.

Work out how many lies and truths he might have told on Monday.

lies and truths

2m

Activity 1 – Pinocchio – Markscheme

Q	Marks	Answer
i	1m	**10**cm
ii	2m	**4** truths
	Or 1m	Shows or implies that the nose needs to shrink **12**cm in total Or Shows **20** and the intent to **repeatedly subtract 3**, e.g. • 15 + 5 = 20 20, 17, 15 (error), 12
iii	1m	Shows why his nose was the same length, e.g. • 3 lies, 3 × 5 = 5 truths, 5 × 3 • Both 15 • Both 3 × 5

At least two subtract 3's must be shown or implied

Activity 1 – Pinocchio – Markscheme (continued)

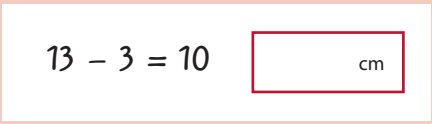
Q	Marks	Answer
iv	2m	**6** lies and **10** truths
	Or 1m	Works with **multiples of 15**, e.g. • Shows 30 Or Works with **multiples of 3 and/or 5**, e.g. • Lists numbers in the 3-times table • Lists numbers in the 5-times table

Accept any pair of values in the ratio 3 : 5, with lies > 3, e.g.

- **9 lies and 15 truths**
- **30 lies and 50 truths**

Activity 1 – Pinocchio – Exemplars

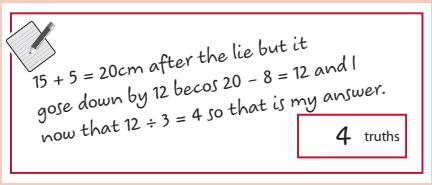
Part i



Correct; **1 mark**

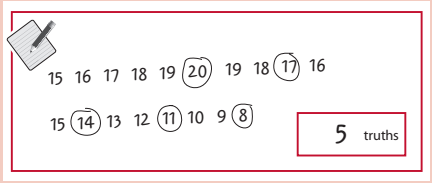
- The answer is clearly shown in the working.

Part ii



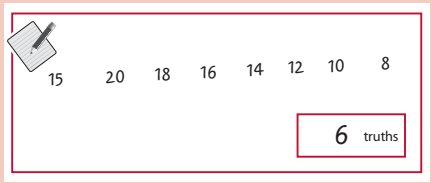
Correct; **2 marks**

- This learner shows good numerical communication.



Shows 20 and repeatedly subtracts 3; **1 mark**

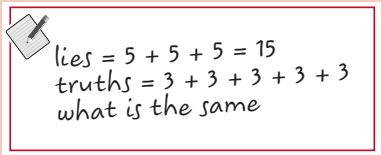
- This learner shows a correct method but has then counted the number of circles, forgetting that 20 does not represent a truth.



Incorrect; **0 marks**

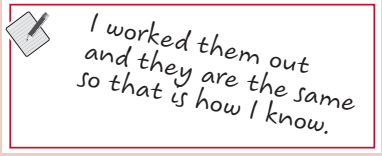
- It is possible that this learner intends to repeatedly subtract 3 but has included the start number when counting back. However, we cannot be sure. Had –3 been shown, in words or numbers, 1 mark could have been given. Note too that although 12 is shown, it is clearly not linked to the amount the nose needs to shrink, so cannot be credited.

Part iii



Correct; **1 mark**

- 'What is the same' implies that the answers to both calculations are equal.

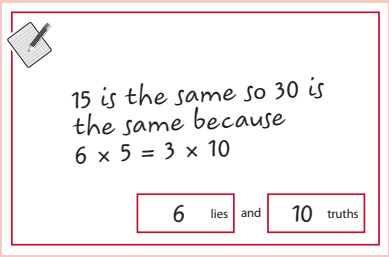


Incomplete; **0 marks**

- There is no evidence to support why 'they are the same', so no marks can be given.

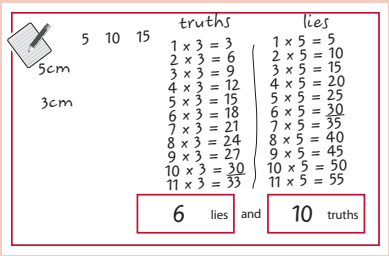
Activity 1 – Pinocchio – Exemplars (continued)

Part iv



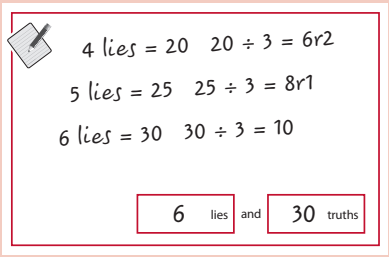
Correct; **2 marks**

- This learner shows numerical insight, recognising, albeit informally, that the number must be a multiple of 15



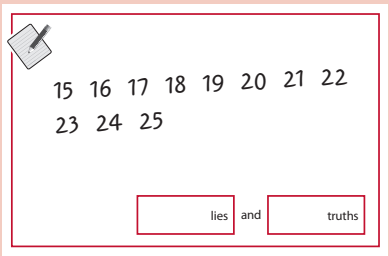
Correct; **2 marks**

- This is an effective but time-consuming strategy. The learner has found numbers that are in both the 3- and 5-times tables.



Works with multiples of 5; **1 mark**

- This learner increases the number of lies by one each time, so is working with multiples of 5. This effective and efficient strategy leads to the correct answer, but there is a slip at the end with 30 rather than 10 written for the number of truths.



Incorrect; **0 marks**

Common error

Simply listing numbers does not show working with multiples, so no marks can be given.

Not attempted; **0 marks**

Common error

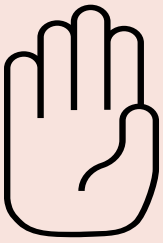
This learner lacks the confidence to try different numbers. Trial and improvement is a useful strategy that can often allow learners to break into the problem and reach a solution.

Activity 2

Pinocchio's challenge

Activity 2 – Pinocchio's challenge

Outline



In this Year 5 activity learners are challenged to double the size of their hand. Little direction is given, so that learners are encouraged to explore for themselves a range of ways of interpreting the instruction to 'double', all of which will give a different outcome.

The fundamental aim of **Pinocchio's challenge** is not for learners to achieve a particular outcome, but rather for them to extend their reasoning skills through the processes they go through. Discussion during, and after, the activity is therefore critical.

You will need

Whiteboard – Pinocchio's challenge

Whiteboard – Different doubling

Teachers' sheet – Different doubling: solutions

Whiteboard – Doubling all over

Whiteboard – Truly doubled

Activity 2 – Pinocchio's challenge

Explain

Remind learners about **Activity 1 – Pinocchio** in which Pinocchio's nose grows and shrinks. Explain that they are going to explore what their hands might look like if they could grow like Pinocchio's nose, then show **Pinocchio's challenge** on the whiteboard. *(Note that the challenge deliberately does not specify what measurement Pinocchio is referring to – the hand could grow from the wrist to the tip of the middle finger, or across the width of the hand, etc. If they ask for clarification, say that you would like them to make their own decision which could be different from that of another group.)*

Give each pair/small group centimetre-squared paper, a ruler, pencil and eraser. As far as possible, let them take their own decisions on how to go about the task, but make sure they realise each pair/group only works on one hand, not all. Support, using the questions as a guide, then when they have completed their drawings, bring the class back together and explore their results.

Show **Different doubling** on the whiteboard and go through each one, asking how the hand has doubled. Solutions are provided in **Different doubling: solutions**. Write the way the hand has doubled alongside each image. Discuss the implications of the challenge being open to interpretation *(the lack of clarity can lead to very different outcomes)*. Conclude by emphasising the importance of using precise language in mathematics *(and life)*. Talking about Pinocchio's nose growing **twice as long** is quite acceptable *(well defined)*, but talking about his hand getting **twice as big** is not!

Question

- How are you going to go about the task? What decisions do you need to take? *(Whose hand, where on the hand to measure, where it will double, how to record, etc.)*
- When exploring their results: why do you think there are differences between your results? *(Different sizes of hand, where to measure, etc.)*
- Why did you choose to double in the way you did? What other ways could you have chosen?
- When showing **Different doubling**: which method of doubling do you think makes most sense? Why? *(Doubling of the whole area, not shown here, could arguably be most sensible; however, Pinocchio's nose only doubled in length, not in area.)*
- The choice of method doesn't really matter in this instance, because Pinocchio is not real. Are there real-life contexts where the lack of clarity in the instructions would matter? *(You could relate this to any task you have set learners recently.)*

Extension

Ask learners what the hand would look like if it doubled all over *(i.e. doubles its area – the common misconception is to assume that it doubles both in length and in width, but that is not the case)*. Show **Doubling all over** on the whiteboard, explain the relevance of the grid *(it gives us an approximate area for the hand)* and allow them to explore, using squared paper, then discuss. *(Using the rectangle as an approximation, the area of the original hand is 24cm^2, so if it doubles all over it should have an area of 48cm^2. However, if you double*

(continued)

the width to 8cm and the length to 12cm, the area becomes 96cm^2 so is much too big – twice as big as it should be.)

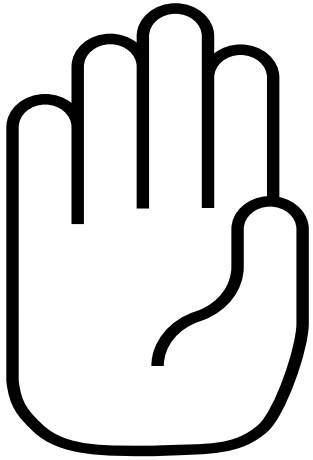
Use **Truly doubled** to show the hand when the length and width are both doubled. The hand on the left clearly illustrates the fact that when length and width are both doubled the area increases by a factor of 4 **not** 2. The hand on the right shows the hand when the area is doubled. The surrounding rectangle would be 5.656...cm by 8.485...cm giving an area of 48cm^2. *(Similarly, if length and width are increased by a factor of 3 the area increases by a factor of 9 (3 × 3), etc. Learners can easily explore this scaling effect for themselves by drawing various rectangles on squared paper and then doubling (or trebling, etc.) lengths and widths.)*

If appropriate, return to **Different doubling** and ask them to look at the area of the surrounding rectangle of the hand if it doubles in width *(Hand B)* or doubles in length *(Hand D)*. *(The area for each is 48cm^2 – the same as the area of the surrounding rectangle when the area of the hand is doubled. That is because only one dimension is being multiplied by two, not both, so the overall effect of the area being multiplied by two is achieved.)*

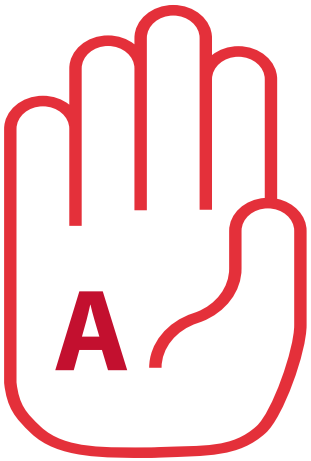
WB

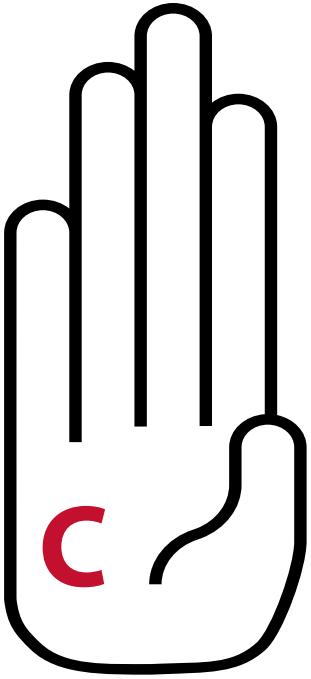
My challenge

Work out what a hand measures if it **doubles** in size.



Then draw the 'new' hand as accurately as you can.


A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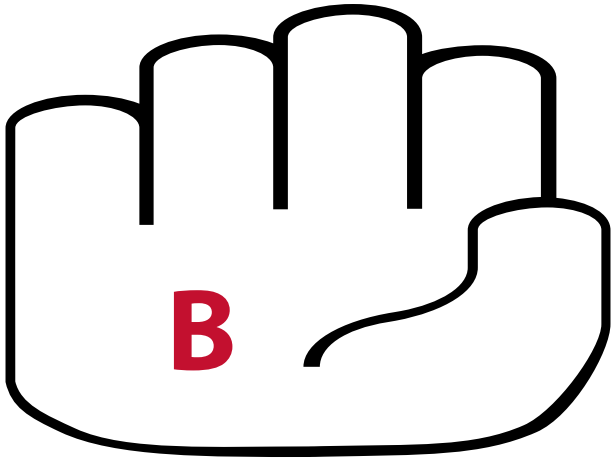
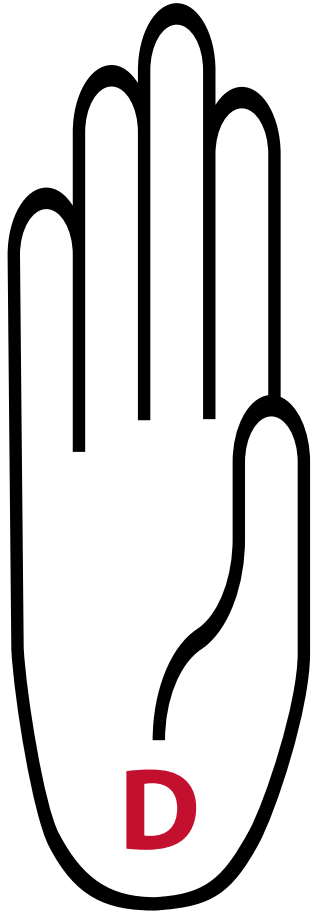

B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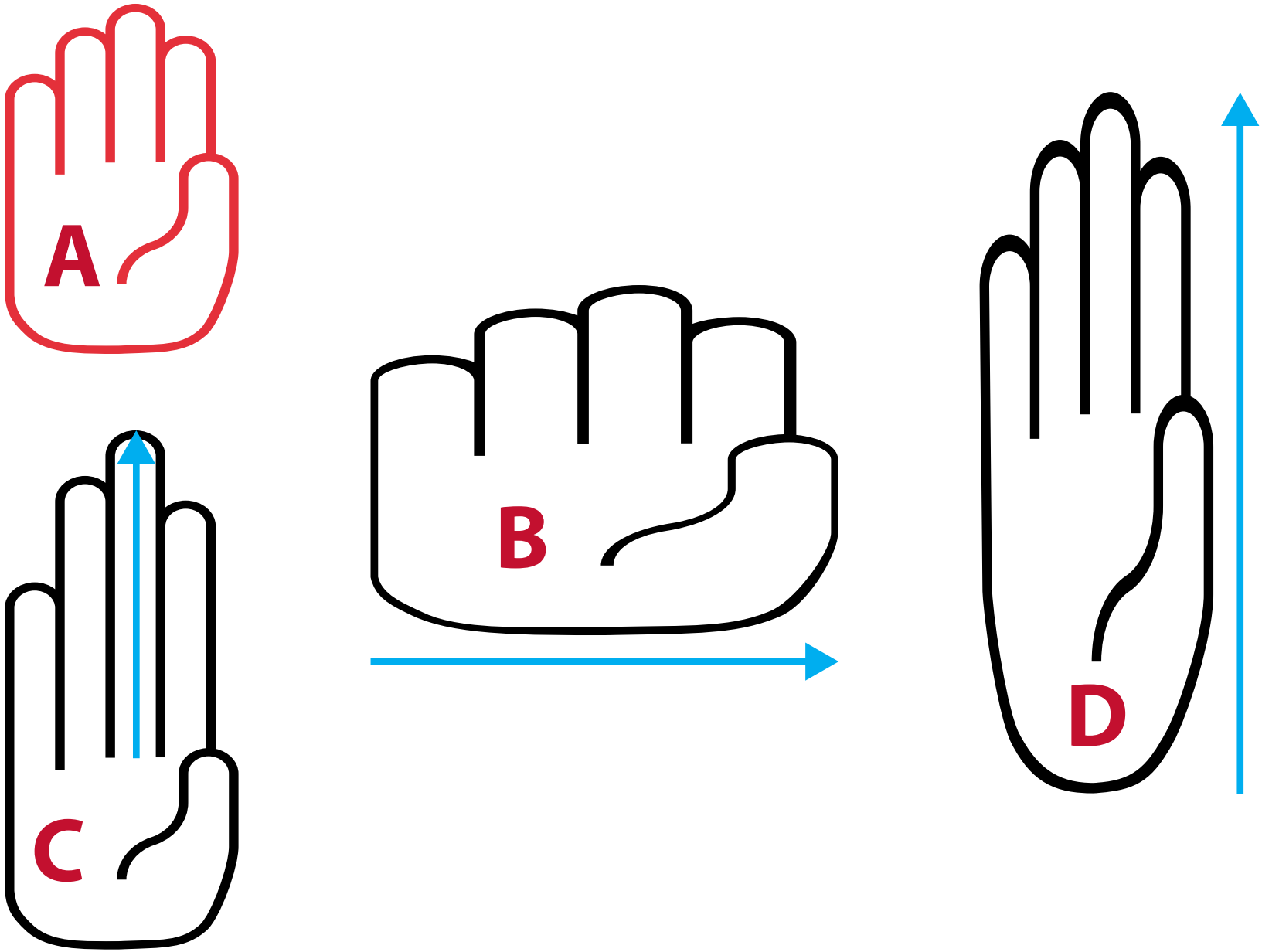
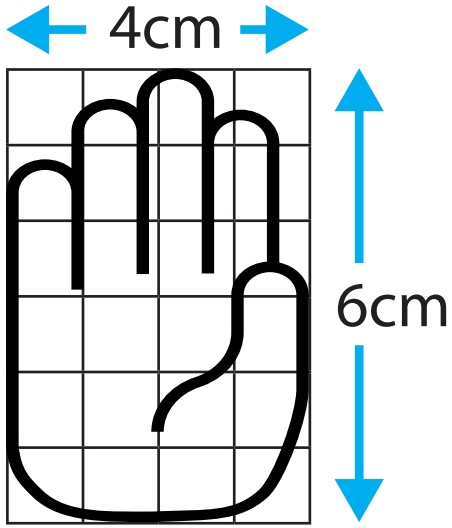

A
B
C
D

WB

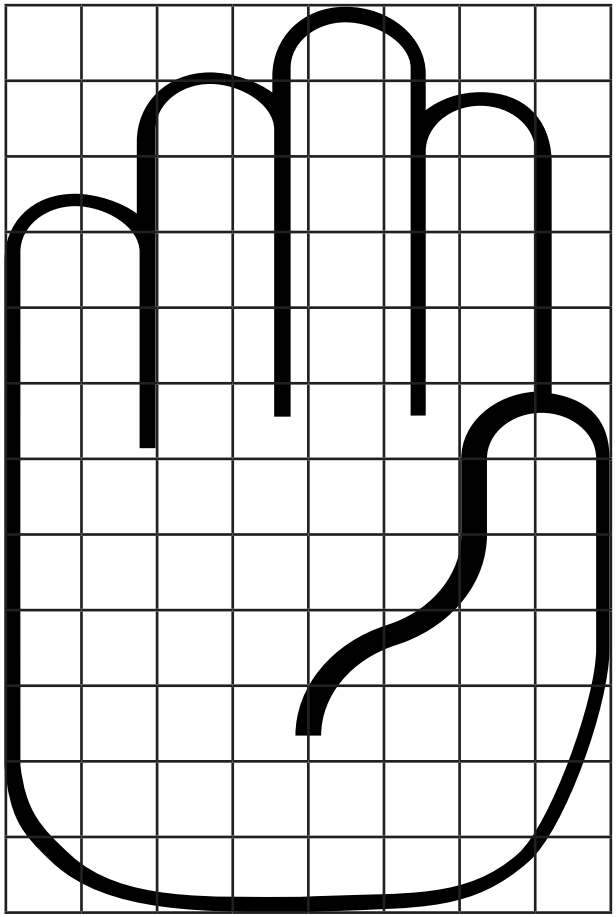


Pinocchio's hand now

If you double both the length and width of my hand, I think its area will also double!

Is Pinocchio right? How do you know?

Pinocchio's hand if both the length and the width double



Area = ____ cm^2

Pinocchio's hand if the area doubles